

I claim:

1. A prefix search key apparatus for storing a prefix key of a preassigned length comprising:

a plurality of memory banks, the number of memory banks determined by at least the number of ordinates within an n-dimension representation, the n-dimension representation defining a coordinate system, each bank associated with one of the ordinates within the n-dimension representation, each bank having at least a number of memory locations equal to the largest valid value for its associated ordinate, each ordinate representing a memory location within the associated memory bank;

a format module for masking out one or more bits from an incoming key, the number of bits to be masked determined by the first prefix key length assigned to the prefix search key apparatus; and

a conversion module for converting the masked key into an n-dimension representation having a plurality of ordinates, the conversion module storing the masked key into one memory location as referenced by one of the plurality of ordinates.

2. The apparatus of claim 1 wherein the incoming key comprises data extracted from an Internet protocol (IP) packet header.

3. The apparatus of claim 1 wherein the means for assigning the prefix key length assigns a second prefix key length whereby the conversion module stores prefix keys having either the first or second prefix key length.

4. The apparatus of claim 1 further comprising:
a demultiplexer for selecting one of two prefix keys stored in the same memory location.

5 5. The apparatus of claim 1 further comprising:
a key matching logic connected to the plurality of memory banks, the key matching logic comparing in a single step a masked key with prefix keys stored at each memory location defined by the n-dimension representation of the incoming key to determine the existence of the masked key.

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6. The apparatus of claim 1 wherein each memory location stores additional information associated with the prefix key, wherein additional information is a class indication, a virtual route indication, a virtual private network indication, or an adjacent table pointer and control indication.

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7. The apparatus of claim 1 wherein the masked key includes a field wherein the field is a class number, a virtual route number, a virtual private network number, or a type of service number.

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8. The apparatus of claim 1 wherein a field is stored with the masked key wherein the field is a pointer to another table entry or a sequence of control bits.

9. A prefix search key system for determining the longest prefix key match with an incoming key, the system comprising:

a plurality of prefix search engines storing one or more keys of an assigned length;

a means for assigning to each prefix search engine a prefix key length to limit the length of prefix keys stored at each prefix search engine, each prefix search engine masking one or more bits from the incoming key defining one or more masked keys, the number of one or more bits masked determined by the prefix key length assigned, each prefix search engine outputting a match indication and a match result if a prefix search engine's masked key matches a stored key;

a priority controller maintaining the prefix length assignment for each prefix search engine, the priority controller receiving one or more match indications, the priority controller outputting a priority signal indicating which match result to select out of the prefix search engines having a match; and

a resulting index multiplexer receiving one or more match results and the priority signal, the resulting index multiplexer selecting the match results to output based on the priority signal.

10. The system of claim 9 further comprising:

a direct mapping module for mapping keys having short key lengths.

11. The system of claim 9 wherein the match result comprises a table entry.

12. The system of claim 9 wherein at least one of the plurality of prefix search engines stores a prefix key having the same lengths as at least another one of the plurality of prefix search engines.

13. The system of claim 9 wherein the means for assigning the prefix key length assigns to at least one prefix search engine a second prefix key length.

5 14. The system of claim 9 wherein each of the plurality of prefix search engines further comprise:

a demultiplexer for selecting one of two prefix keys stored in the same memory location.

10 15. The system of claim 9 wherein the incoming key comprises data extracted from an Internet protocol (IP) packet header.

16. The apparatus of claim 9 wherein the matched result includes a field wherein the field is a class number, a virtual route number, a virtual private network number, a
15 type of service number, a pointer to another table entry, or a sequence of control bits.

17. A method of determining the longest prefix key match in a database of prefix keys with an incoming key, the method comprising:

routing an incoming key to the plurality of prefix search engines;

20 masking one or more bits of the incoming key to define a masked key, the number of one or more bits masked determined by the prefix key length assigned to the respective prefix search engine;

converting the masked key to an n-dimension representation;

retrieving one or more prefix keys stored in memory locations referenced by the n-dimension representation;

reporting a match indication and a match result if the masked key matches a stored prefix key;

5 receiving one or more match indications and one or more match results; and
selecting the match result out of the prefix search engines reporting match indications from the prefix search engine configured to store the largest prefix key size.

10 18. The method of claim 17 further comprising:
populating a direct mapping module with prefix keys having a length shorter than key lengths configured.

19. The method of claim 17 wherein the match result comprises a table entry.

15 20. The method of claim 17 wherein at least one of the plurality of prefix search engines stores a prefix key having the same lengths as at least another one of the plurality of prefix search engines.

20 21. The method of claim 17 wherein the configuring step further comprises configuring to at least one prefix search engine a second prefix key length.

22. The method of claim 17 wherein the plurality of prefix search engines further comprise:

a demultiplexer for selecting one of two prefix keys stored in the same memory location.

23. The method of claim 17 wherein the incoming key comprises data extracted from an Internet protocol (IP) packet header.

24. The apparatus of claim 17 wherein the match result includes a field wherein the field is a class number, a virtual route number, a virtual private network number, a type of service number, a pointer to another table entry, or a sequence of control bits.